Title: Parking Meter Mania

Brief Overview:

Given data based on real life information, students will examine, estimate, predict, calculate, graph, and design problems based on the following data -- **In the city of Washington, D.C., there are 15,000 parking meters that roughly generate $1,000,000 weekly. What do you think about this statistic? Can you prove if it is possible?**

Links to NCTM 2000 Standards:

- **Mathematics as Problem Solving, Reasoning and Proof, Communication, Connections, and Representation**
  These five process standards are threads that integrate throughout the unit, although they may not be specifically addressed in the unit. They emphasize the need to help students develop the processes that are the major means for doing mathematics, thinking about mathematics, understanding mathematics, and communicating mathematics.

  Students will demonstrate abilities to answer questions based on statistical data, apply known strategies to solve problems, and work cooperatively using computer and/or calculator technology to present their findings. They will share their solutions through questioning and supporting their information through discussion and written explanations.

- **Number and Operation**
  Students will demonstrate their ability to perform basic mathematical computations and choose the appropriate operation to fit a problem. They will use their estimating skills in both answering questions and predicting outcomes.

- **Measurement**
  Students will demonstrate their ability to measure an area and assign proportionate spaces by designing a graphic model of an area.

- **Data Analysis, Statistics and Probability**
  Students will demonstrate that they can generate data using charts, graphs and spreadsheets. They also can make predictions based on their calculations and data analysis whether or not it is possible to generate $1,000,000 using 15,000 parking meters.

Links to National Science Education Standards:

- **Science as Inquiry**
  Students will use their thinking and questioning skills to hypothesize if 15,000 parking meters will generate $1,000,000. From that hypothesis they will determine a strategy to chart combinations and data related to the problem in order to draw a conclusion. They also will investigate various types of parking meters through research and list questions about the mechanics of a parking meter as a machine.

- **Physical Science**
  Students will work cooperatively to make a model of a parking meter using their creative talents along with their knowledge of simple machines and diagrams of parking meters.

Grade/Level:

Grades 5, 6, and 7

Duration/Length:

Five to seven class periods based on the time spent for research, design, construction, and problem solving.

Prerequisite Knowledge:

Students should have working knowledge of the following:

- Research techniques : Internet, library, outside resource such as Police Dept.
- Computational and operational strategies for solving number problems
- Basic chart and graphing knowledge - how to set up a chart and graph to incorporate data
- Calculator basics - being able to key in number problems and operation

Student Outcomes:

The students will:

- calculate the various possibilities of generating $1 million from 15,000 parking meters.
- prepare a chart/graph or spreadsheet to display their data.
- research facts/figures on parking meters.
- prepare a statement to show proof or disproof to the given data.

Materials/Resources/Printed Materials:

- Calculators
- Computers for spreadsheet/Internet/graphing
- Paper and pencils/overhead projector and transparencies
- Materials to construct model parking meter: paper towel tubes, plastic containers and lids, scissors, tape, coins
- Worksheets for questionnaire, teacher generated problems

Development/Procedures:

Day One/Step One:

- Hand out a questionnaire (Activity One /Worksheet #1) to each student. Give them approximately 15 minutes to fill it out. If they finish early let them begin to investigate the following:

  On an overhead transparency print out the following statement: "In the city of Washington D.C. there are approximately 15,000 parking meters. It has been stated that these meters can generate $1,000,000 weekly. Do you agree with this statement ? Why or why not?" When the 15 minutes are up have the students discuss the statement in their small groups (arranged by tables of 3 to 4). Appoint a spokesperson from every group to give the consensus of the group. Spend 5 minutes discussing the problem. At the end of the discussion period ask each spokesperson to stand and report their groups standings - how many agree? How many disagree?

Day One/Step Two:

- Announce to the students the following task (it is printed out on Activity Two /Worksheet #2 - there are two options for the teacher to select.)

Option One: (Student Generated Worksheet/Chart)

"Knowing what you know about parking meters, what combination of coins are possible to put in each meter to help generate this $1 million?"

With your group, decide upon a strategy to discover these combinations and devise a chart to display your work.

Option Two: (Using Worksheet #2)

Use the following chart to list the possible coin combinations that will generate $1,000,000.

Extension Activity/Homework after Day One:

Ask the students to search the Internet and/or library for any interesting trivia/facts/ features about parking meters. Example : Did you know that there was a band with the name "The Parking Meters?" Also bring in any designs/materials that might be useful to construct a meter.

Day Two/Step One:

- Have a brief discussion of any information the students want to share from their Internet searches. Record any data on the class chart that might pertain to this problem. Example: How much money can the average parking meter hold? Along with this ask the students to generate more questions and record them. These questions may be used for future extensions and research.

- Ask group spokes people to share their findings from Activity Two/Worksheet #2. If possible make transparencies to show the entire class. Discuss their findings for approximately 10 minutes. Use the following questions (and any others) to help lead the discussion:

  1) Are there any relationships or patterns in your data?
  2) Did your group use a system to listing the possibilities?
  3) What could you do with this data?
  4) How do you think it compares to other cities?
  5) What tools did you use to help you solve the problem?
  6) Do you think there is a more efficient way to do this problem?

- After the discussion, lead the students into Activity Three/Worksheet # 3/Spreadsheet.

Day Two/Step Two:

Learning How to Use a Spreadsheet/Activity Three/Worksheet #3
(this step requires the use of computers)

The following activity is to teach students how a spreadsheet works. There may be a group that knows the basics of charting and computing with a spreadsheet. For those students the teacher may choose to give the Activity/Worksheet to them and let them work independently. For others use one or both of the following steps.

- Have all the students working on a computer as you go through the steps - checking that everyone is understanding the activity.
- Follow Extension #2 to teach how a spreadsheet works before working on a computer.

Day Three:

Parking Meter Chart Activity

Use Worksheet #4 for this activity. Give the students data and have them compute the earnings for a meter using a variety of situations. Develop problems for a different number of hours per day of the week, different rates of hourly use and different periods of time. For example: For one week compute the earnings of a meter which has an hourly rate of $.50 and was used for the following times: Monday, 2 hrs; Tuesday, 5 hrs; Wednesday, 1hr; Thursday, 4 hrs; Friday, 8 hrs; Saturday, 10 hrs; and Sunday, 0 hrs. Have the students use the chart to record the data. This information can then be used later for graphing activities.

Graphing Activity

Using Graph Worksheets #5 & 6, give the students your directions to design line graphs and bar graphs comparing meters using two or more hourly rates. Have them title the graph, create a key identifying each of the meter rates, label the axes, and enter the previously assigned or computed data. Create a series of questions to analyze the graphs and use it as an assessment of their understanding of the interpretation of graphs and data. For example:

What days of the week generate the most income for the meter?
If you need to generate a $66. per week, what hourly rate must you charge?
How much money would you lose if a meter were not in effect for a Monday holiday?
What is the most reliable way to increase revenue? Support your conclusion.

Day Four:

Parking Meter Space Activity

Use Worksheet #7 for this activity. Students may work individually or in groups. This activity uses spatial visualization. The students will construct the perimeter of a building by using a graph sheet. The students will calculate the number of parking meters and car space the building can use giving certain information.

Days Five through Seven:

Parking Meter Construction

This activity could be supplemented at any point in this unit. Students collect materials and work in small groups to build a model parking meter. This is a hands on experience for the students to test their knowledge in a constructive learning activity. There are no specific instructions except to give ample time and try to provide any materials that are available.

Performance Assessment:

- To assess the work on this unit, use all or any of the following based on teacher preference:

  - Rubrics which are included with worksheets
  - Written Assessment Essay - see attached

Extension/Follow Up:

- Students will use a computer graphics program to design a parking meter and write a brief summary how their meter design would work.
- Students will use the Internet and other resources to discover facts/designs for parking meters.
- Students will apply their knowledge of graphing and spreadsheets to future data collections in Math and Science.
- Students will learn how to enter their data on the graphing calculator to further their technological knowledge.

Additional resources included after worksheets

- **Picture/Designs of parking meters found in "*The Way Things Work*" by David Macauly, Houghton Mifflin Company**
- **Most Asked Questions**
- **Internet Resources: POM Parking Meters, http://www.pom.com/smartlock.html**
- **Teacher made design for parking meter**

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PARKING METER MANIA

Worksheet #1

Questionnaire on Parking Meters

Name _____ Date : _____

Please answer each question below. If you want to use the sides for work space, please do so.

1. Have you ever put money into a parking meter? _____

2. What coins will fit into most parking meters? _____

3. Why do you think that pennies are not allowed in meters?

_____

4. What do you think is the most amount of money that will fit into a parking meter?

_____

5. What do you think and / or know about the time allocated on a meter and the money charged?

_____

_____

_____

6. Explain how you think a parking meter works after the money is deposited?

_____

_____

_____

_____

_____

7. What other machines can you list that possibly work in the same way?

_____

_____

_____

8. Use the other side of this sheet to sketch a parking meter and label any of the parts you can.

Worksheet #2

ACTIVITY TWO

NAME _____ **Date:** _____

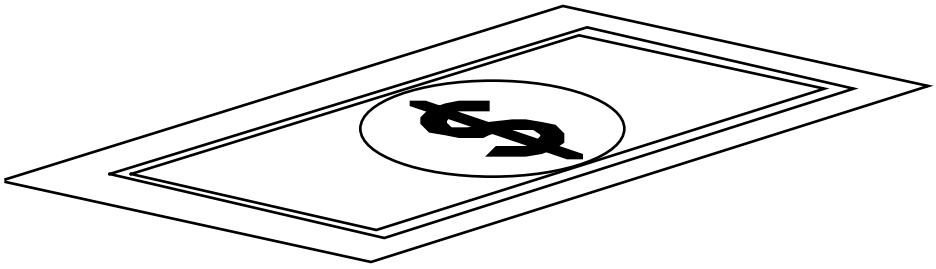
Use the following chart to list the possible combinations of coins in only one of the parking meters that generate $1,000,000. If you need more space continue the chart in a method that suits you best.

Hint : Remember from the previous information that there are 15,000 meters. How much money would the average meter need to collect in order for the total of all the parking meters to be $1,000,000?

Nickels	Dimes	Quarters	Sum

Worksheet # 3

SPREADSHEET ACTIVITY



NAME _____ DATE _____

The following information will help you build a spreadsheet for the data you collected on the parking meter problem. You will need to fill in this sheet as you work on the computer. Please work with a partner if you need help. This is a practice activity to help you learn the steps of a spreadsheet program. Once you have "mastered" this you can use your own data from your "Parking Meter Chart" to create a spreadsheet to match your chart.

1. Once you have opened the spreadsheet program you should begin to place the data into the appropriate cells. The following design should be helpful to show you how to insert your data.

Meters	Nickels	Dimes	Quarters	Sum
meter 1	10	10	10	$4.00
meter 2				$0.00
meter 3				$0.00
meter 4				$0.00
meter 5				$0.00
meter 6				$0.00

- In **Column A1** type in **meters.** This column will list your parking meters by number.
- In **Column B1** type in **nickels.**
- In **Column C1** type in **dimes.**
- In **Column D1** type in **quarters.**
- In **Column E1** type in **sum.**

2. You are now ready to enter your data. Start with **Column A.** Put your cursor in **Column A2.** Click on the mouse and you should type in **meter 1.** Repeat this step in **Column A** to list up to **meter 5.**

3. Click on **B2** and enter any number of **nickels.** Click on **C2**, enter a number for dimes. Repeat this step for **D2.**

4. For the **Sum** column you will have to discover a way to create a formula to take those numbers in **B2, C2, and D2** which have different values assigned to them because of the coins and find their sum.

• How do you think that the computer got an answer of $4.00 in **E2?**

Write your solution below.

5. Fill in all of **Columns B, C,** and **D.** with a variety of numbers. When you have done that try this step which will quickly help you find the sums for **Column E.**

• Click on **E2.** Type the following :

= (B2 * .05) + (C2 * .1) + (D2 * .25)

• Highlight **E2** through **E6.**

• Go to **Calculate** in the **Menu Bar.** Click on **FILL DOWN.**

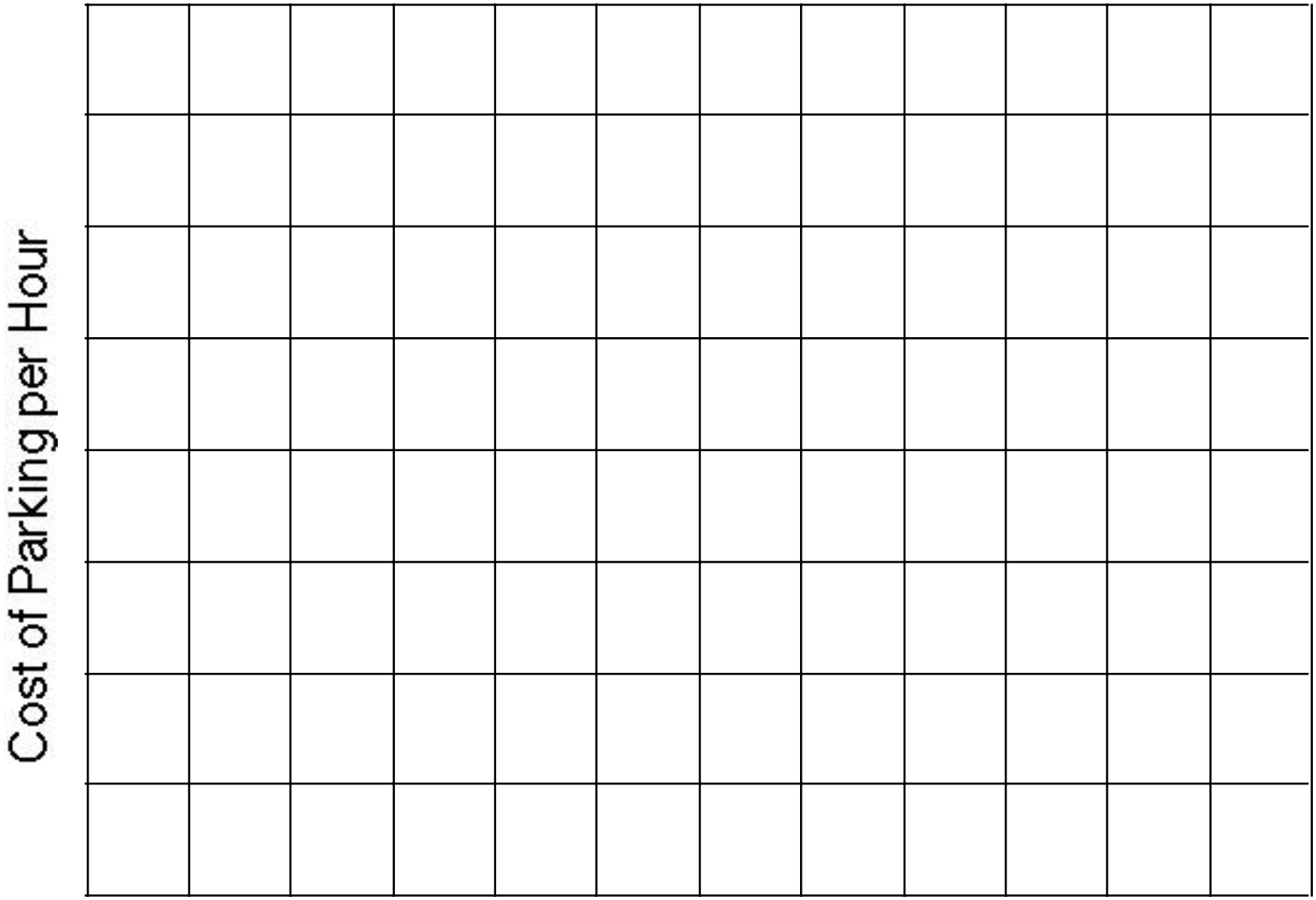
• Click on **E3 .** What do you see in the Entry Bar Cell Address Box?

Hopefully this exercise will show you how to quickly add a formula in your spreadsheet. To test to see if it works - click on **E3.**

• Write a proof below that proves the sum stated in **E3** is correct.

6. You are now ready to tackle a new spreadsheet using your individual data from **Activity One. This will be part of your final assessment.** To start you will need to open a new spread sheet. When you finish save your work and print out a copy to hand in.

Parking Meter Income Chart

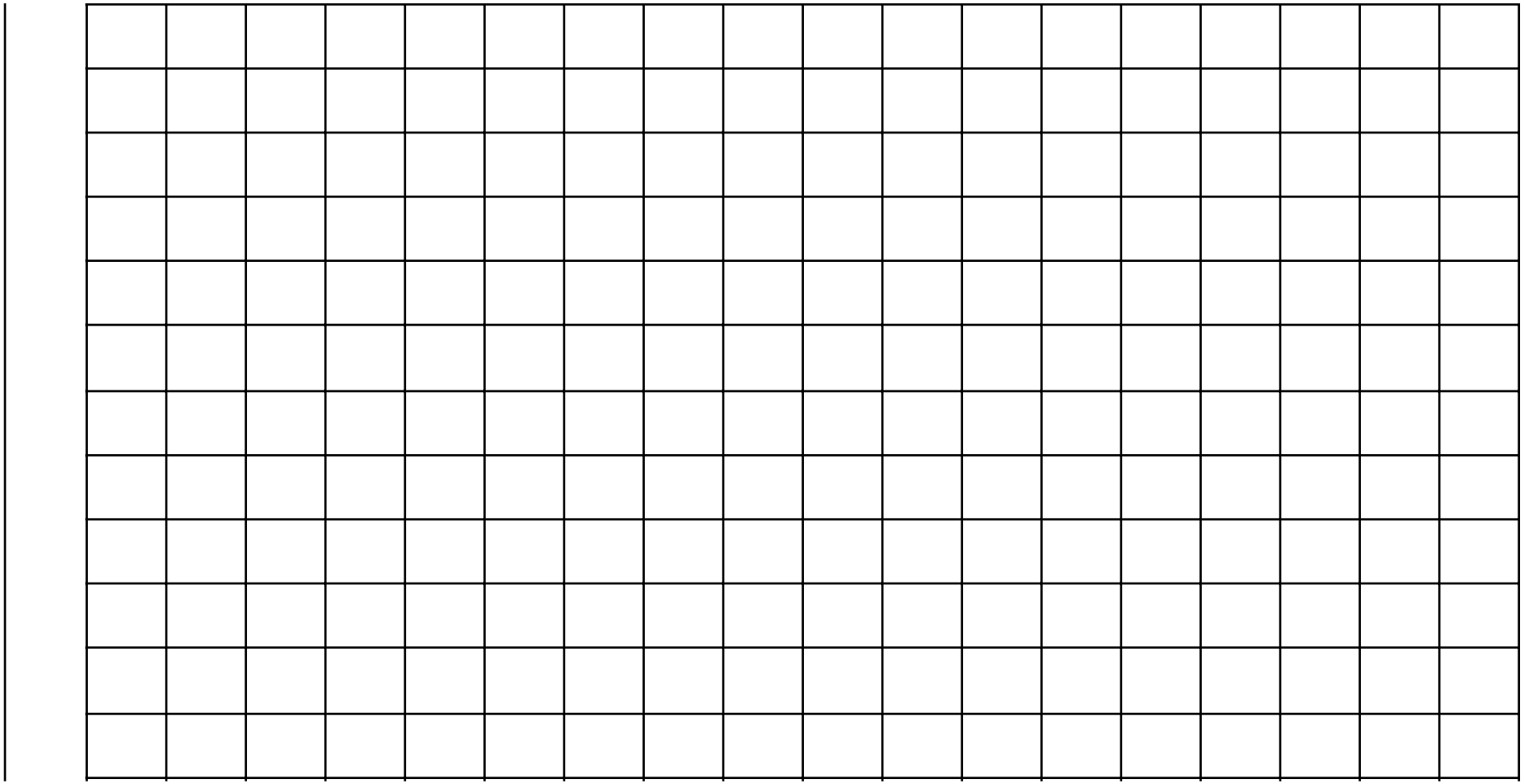


Worksheet #5

GRAPH #1

KEY

TITLE _____



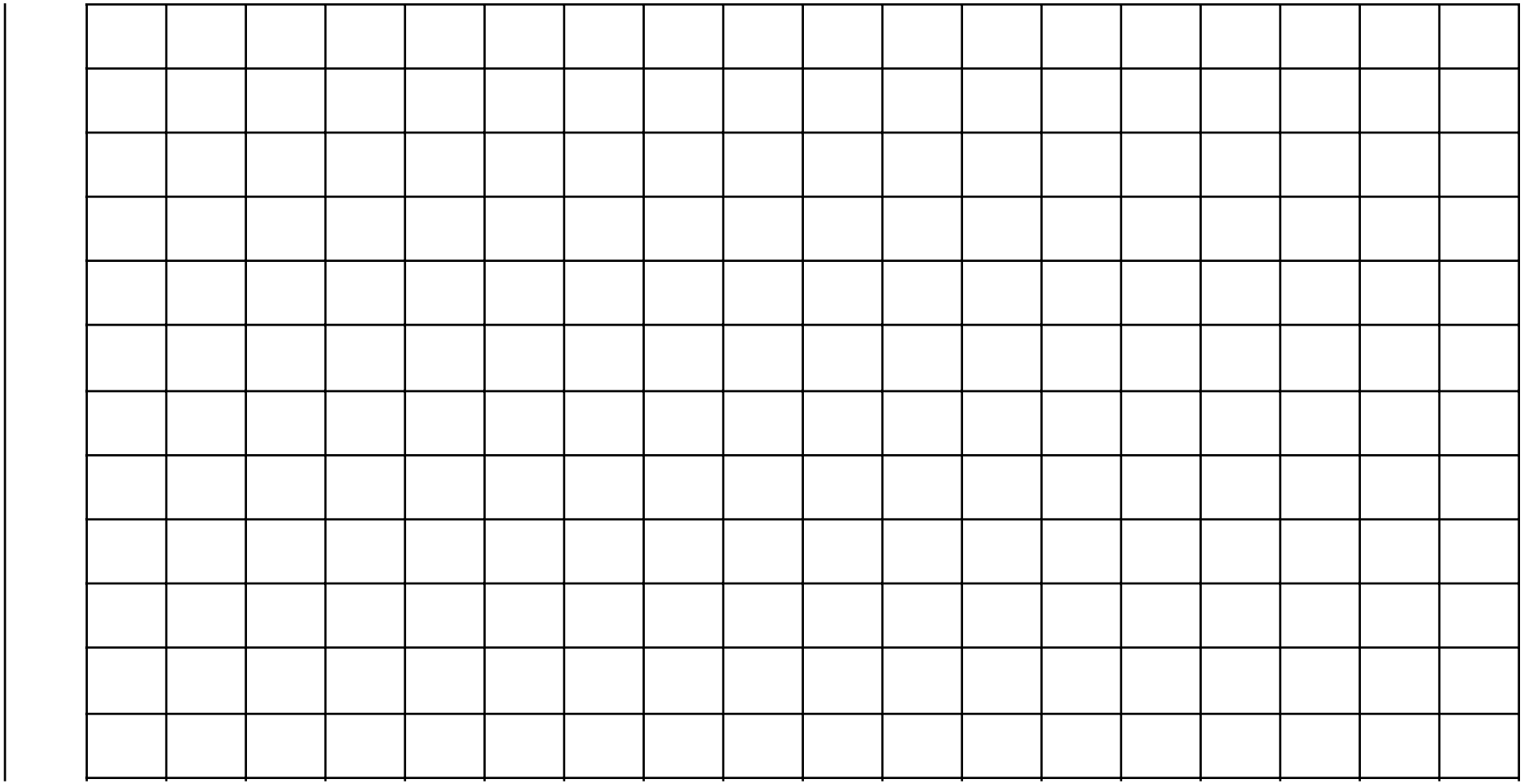
_____

Worksheet #6

GRAPH #2

KEY

TITLE



Activity #7 PARKING METER SPACE

Needed information:

Materials - graph sheet, ruler, and calculator if needed
Each car space is about 5 meters in length.
The perimeter of the building is 120 meters.

Problem:

Part 1:

Have students generate a chart or use a graphing calculator to determine the largest rectangular area having a perimeter of 120 meters. Have them show on their chart width, length, and area using a total of 120 meters. Draw the perimeter of the building on the graph paper.

Part 2:

The parking garage is always full and expensive. The owner of the building wanted to provide more parking space for his customers. The cost for this project is expensive, so he decided to use parking meters to offset the cost. Using the information from Part 1, answer the following questions:

1) How could you measure the spaces for the cars?
2) What are the most number of cars you can park using only three sides of the building?
3) How many parking meters can be placed on one side of the building?
4) How many parking meters are needed overall?
5) How many double parking meters can be used?
6) List two other questions that you might investigate with this activity.

For further extension:

Use the computer and sketch a design to go with your solution.

ASSESSMENT ACTIVITIES

RUBRIC A

COMPUTATIONAL ASSESSMENT (Assessing computational skills)

3 Points	**• all correct**
2 Points	**• 75% correct**
1 Point	**• 50% correct**
0 Points	**• less than 50%**

RUBRIC B - This rubric is to evaluate the following for the graphing activities.

Worksheet #5

Neatness	3	2	1	0
Accurate information	3	2	1	0
Response to interpretive questions	3	2	1	0

Worksheet #6

Neatness	3	2	1	0
Accurate information	3	2	1	0
Response to interpretive questions	3	2	1	0

Worksheet #7

Neatness	3	2	1	0
Accurate information	3	2	1	0
Response to interpretive questions	3	2	1	0

Assessment Essay

Students will write a brief essay to examine the following points:

- What have you learned about parking meters through this activity?

- Do you think parking meters should be used more extensively or less? Why or why not?

- How do your data and group discussions help you formulate an opinion about parking meters in general?

- If you were a city or town official in charge of parking meter control what changes and/or additions would you incorporate?

Rubric for Essay Assessment:

4 Points

- **answered all the above questions**
- **included references to group work, data**
- **research included**
- **neatly written or typed and well organized in paragraph form**

3 Points

- **answered all the questions**
- **included references to group work, data**
- **neatly written or typed and well organized in paragraph form**

2 Points

- **answered one half of the questions**
- **neatly written or typed and well organized in paragraph form**

1 Point

- **answered one of the questions**
- **neatly written or typed and well organized in paragraph form**

Teacher Idea for Parking Meter Model

Materials :

- **one plastic container - preferably about the size of a margarine tub or larger with lid**
- **scissors, masking tape**
- **piece of shirt cardboard or tagboard**
- **toilet paper tube**

The idea is to let the students try to design a parking meter model from these materials. It is basically a system where the coins will drop through the tube onto the cardboard which is somehow attached to the lid (which has holes the size of coins cut into it.) The cardboard should be measured larger than the lid, so as to rotate it as the coins drop through the tube.

There is no magic method or specific steps.

Enjoy and good luck.